



IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Patent Application of)	Mail Stop After Final
Si Yi Li et al.)	Group Art Unit: 1763
Application No.: 09/820,695)	Examiner: ALLAN W. OLSEN
Filed: March 30, 2001)	Confirmation No.: 4162
For: METHOD OF PLASMA ETCHING)	
LOW-K DIELECTRIC MATERIALS)	

PRE-APPEAL BRIEF REQUEST FOR REVIEW

Commissioner for Patents
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Sir:

Applicants request review of the October 25, 2006 final rejection of Claims 1-3, 7, 9, 10, 12-17, 19-25 and 27-30 in the above-identified application. No amendments are being filed with this Request. For at least the following reasons, withdrawal of the outstanding rejections is respectfully requested. This Request is being filed with a Notice of Appeal.

Overview

This Request addresses the following issues: (I) no reasonable expectation of success has been established for the combination of Hsieh and Kim; and (II) there is no basis for the rejection over Ito and the proposed modification would render Ito unsatisfactory for its intended purposes.

I. Claims 1, 9, 10, 12, 13, 19, 20, 27, 29, and 30 - No Reasonable Expectation of Success Has Been Established

The Claims stand rejected over Hsieh in view of Kim. Claim 1 recites, *inter alia*, a process for etching a low-k dielectric layer, the etching gas consisting essentially of N₂, C₅F₈, and optional carrier gas (emphasis added).

The Official Action acknowledges that Hsieh does not disclose an etchant gas consisting essentially of $C_5F_8/N_2/Ar$ as recited in Claim 1 (final Official Action at page 3, lines 3-4) and cites Kim to allegedly cure this deficiency because "Kim teaches the functional equivalence of [$C_5F_8/NH_3/Ar$ and $C_5F_8/N_2/Ar$] etchant mixtures" (final Official Action at page 3, lines 8-10). Applicants respectfully disagree, because the Official Action has made no showing that nitrogen would function equivalently to ammonia in achieving a vertical profile, as disclosed by Hsieh (column 5, lines 57 to column 6, line 40; Table 2). As such, the rejection fails to establish that there would have been "a reasonable expectation of success" if N_2 was substituted for NH_3 of Hsieh. *In re Vaeck*, 947 F.2d 488, 20 USPQ2d 1438 (Fed. Cir. 1991); MPEP § 2143.

A. Hsieh Requires NH_3 to Remove Polymer Deposits for Achieving a Vertical Etch Profile and Discloses No Substitutes for NH_3

Hsieh requires a "source gas comprising NH_3 and C_xF_y " (column 3, lines 65-67) so that a polymer layer from the C_xF_y gas deposits on the photoresist, preventing it from being etched during the etching of the silicon oxide (column 2, lines 20-25). Hsieh requires NH_3 and states that "[s]imultaneously, the ammonia (NH_3) ... of the plasma source gas functions to 'clean up' deposited polymer on the photoresist surface ... [i]t is necessary to achieve the proper balance between the C_xF_y and NH_3 ... in order [to] provide a balance between by-product polymer deposition and removal on various surfaces of the substrate being etched" (column 2, lines 26-30). Furthermore, Hsieh discloses that the function of the NH_3 is to reduce polymer deposits for the purposes of achieving a vertical etch profile (column 7, lines 28-32; column 5, lines 57 to column 6, line 40; Table 2). As such, NH_3 is required to achieve vertical etching and Hsieh discloses no alternatives to NH_3 to achieve the same result. Use of N_2 would provide only nitrogen and no hydrogen, making N_2

chemically non-equivalent to NH_3 . Moreover, use of N_2 in place of NH_3 in the Hsieh process would have an unknown effect and as such, it would not be expected to achieve the same result.

B. Kim Discloses a Different Process than Hsieh Wherein NH_3 and N_2 Increase the Etch Rate of BPSG or PSG Relative to Si_3N_4

Kim discloses that "in order to [increase] the etch rate between the interlayer insulating layer 15 [BPSG or PSG] and the underlying etch stop layer 14 [Si_3N_4], N_2 or NH_3 gas is added in the fluorine gas etchants" (column 3, lines 62-65). Kim etches a different structure and uses N_2 for a different purpose than NH_3 in the Hsieh process. No mention is made in Kim regarding the effect of N_2 or NH_3 on reducing polymer buildup or achieving vertical etching. Thus, Kim fails to provide any basis to conclude that N_2 would be expected to achieve the beneficial result of NH_3 in Hsieh.

C. Lack of Substantial Evidence for Motivation to Combine Hsieh and Kim

The Official Action contends that there is a reasonable expectation of success in substituting N_2 for NH_3 because: (i) "Hsieh teaches that the oxide layer being etched is itself a source of hydrogen"; and (ii) "when discussing the flow ratio between NH_3 and C_5F_8 , Hsieh teaches that it is the carbon to nitrogen ratio that is important" (final Official Action at page 7, lines 4-9). As to both points, Applicants respectfully submit that commonly owned Ho et al. (U.S. Patent No. 7,105,454) provides evidence that in plasma etching low-k dielectrics, NH_3 prevents bowing (i.e., produces a vertical etch profile) by reacting with the dielectric to produce a polymer containing $-\text{NH}_2$ groups, thus passivating the sidewalls (column 9, lines 33-40). Ho et al. establishes that N_2 causes bowing (column 3, lines 1-10), whereas NH_3 is used to prevent bowing (column 9, lines 33-43). Accordingly, as evidenced by Ho et al.,

N₂ and NH₃ are not functionally equivalent and substitution of N₂ for Hsieh's NH₃ would be expected to detrimentally produce a non-vertical etch profile.

An obviousness rejection must be based on "evidence relevant to the finding of whether there is a teaching, motivation, or suggestion to select and combine the references relied on as evidence of obviousness." *In re Lee*, 277 F.3d 1338, 61 USPQ2d 1430, 1434 (Fed. Cir. 2002) (emphasis added). Furthermore, the Patent Office must "identify specifically the principle, known to one of ordinary skill, that suggests the claimed combination." *Id.* Moreover, particular findings must be made as to the reason the skilled artisan, with no knowledge of the claimed invention, would have selected the components for combination in the manner claimed. See *In re Kotzab*, 27 F.3d 1365, 1371 (Fed. Cir. 2000). The Official Action has provided no evidence as to "a teaching, motivation, or suggestion to select and combine the references relied on as evidence of obviousness" in support of the alleged motivation of replacing NH₃ in Hsieh with N₂ of Kim.

II. Claims 22-24 and 28 - The Proposed Modification Would Render Ito Unsatisfactory for its Intended Purposes

Claims 22-24 and 28 stand rejected over Ito alone or in view of Ku. Claim 22 recites, *inter alia*, a process for etching a low-k dielectric layer with selectivity to an overlying mask layer (emphasis added).

The Official Action contends that "[w]hen the etch of via 210 extends below the upper surface of nitride layer 206 Ito's process comprises the claimed process" (emphasis added) (final Official Action at page 7, lines 19-22) and alleges that it would have been obvious to use an etching gas with a total C₄F₈ and CF₂H₂ flow rate that is 30% or less than the N₂ (final Official Action at page 4, line 16 to page 5, line 3). Applicants respectfully disagree, because as shown in Ito's FIGs. 2-7 and 9-14,

via **210** stops at silicon nitride etch stop layer **206**. Thus, Ito has been misconstrued in the final rejection.

Moreover, Ito expressly teaches away from etching through silicon nitride etch stop film **206** and underlying insulating film **204**, as illustrated in FIG. 15, where "SiO₂ film layer **204** covering the gates **202** became etched and ultimately damaged" (emphasis added) (column 14, lines 50-52). Ito discloses preventing "damage to the shoulder of the SiN_x film layer [**206**]" (column 3, lines 6-7) such that "the insulating film layer [**204**] covering the gates protected by SiN_x film layer [**206**] ... [is] not exposed inside the contact holes, [because] defective insulation at the gates and the occurrence of breakdown are prevented" (column 3, lines 6-12). Thus, the proposed modification of Ito to etch insulating film **203** underlying silicon nitride film **204** would improperly would render Ito unsatisfactory for its intended purposes by creating defective insulation at the gates and the occurrence of dielectric breakdown. MPEP § 2143.01(V). As such, there is no suggestion or motivation to make the modification proposed in the Official Action.

Conclusion

For at least the foregoing reasons, Applicant respectfully submits that all pending claims are allowable, and this application is in condition for allowance.

Respectfully submitted,

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Date: January 19, 2007

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